

INFORMATION REPORT

CD NO.

COUNTRY

Iran

DATE DISTR. *5 JUN 51*

SUBJECT

Bandar Abbas Fish Canning Factory

NO. OF PAGES 1

25X1C

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REPORT ON THE
SANPOL ARDAS FISH CANNING FACTORY
BY
Dr. Nitro Petersen

Report on the investigation of the Fish canning factory
at Bandar Abbas.

I. The start of the factory.

The fish canning plant at Bandar Abbas started operations in 1941 with a rated capacity of about 2,000,000 cans per year, mainly on sardines, but the production also of tuna and shrimps was planned. The intended production has never been reached, however and 4000000 cans in one season has been the maximum thus far.

The main reasons for the reduced production has been the continued lack of raw material. The two danish fishing boats, originally purchased for the factory were taken away in 1942 and later were so heavily damaged that they would have been of little or no use to the factory. It was therefore necessary to rely on the catches of local fishermen, which have proved to be quite insufficient.

In the neighbourhood of Bandar Abbas three main landing places are found; for sardines;

- a. On the northern side of the island Hormuz a landing place with about 80 nets is found. The time of transportation to Bandar Abbas is 2-3 hours.
- b. On the northeastern side of the island Qeshm a landing place with about 15 nets is found. Time of transportation to Bandar Abbas is 3-5 hours.
- c. On the southern side of Qeshm, about in the middle of the island, a landing place with about 15 nets is found. Time of transportation to Bandar Abbas is abt. 10 hours.

In the hot climate of Bandar Abbas, Sardines will keep only for few hours in a condition fit for canning purposes, and as the local boats cannot carry ice, only the landing places a. and b. can be of use to the factory.

After the transportation to Bandar Abbas, the sardines must be transported to the factory by lorry, and even if the sardines are caught in the morning, they normally arrive at the factory too late for preparation on the same day, and thus it has been necessary to store them overnight.

The result has been, that the factory normally been working with insufficient raw material supply and with sardines of impaired quality. Even if every effort has been made to grade the sardines, raw material of satisfactory quality has been impossible.

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II. Investigation on the raw materials of the factory.

In the laboratory, established at the factory, analyses of the raw materials have been carried out. In a sample of 50 sardines, caught at Qeshm on the 27 March 1950, the average length was 16.2 cm and the average weight was 44.6 grams. The dry matter content of the sardines was 25.8% and the oil content 4.0%.

With a view to investigating the keeping qualities of the sardines, determinations of the volatile nitrogen content have been carried out. The sardines were packed in ice immediately after the catch and were kept in ice during the experiments. The first analyse, carried out 24 hours after the catch showed a content of volatile nitrogen of 14 mg per 100 g. of meat. After 96 hours storage the figure had risen to 198 mg per 100 g. of fish meat, and as 25 mg per 100 g. of fish meat is considered the upper limit of edibility, it would appear, that the sardines must be used very soon after the catch.

In this connection it must be remembered, that the velocity of the formation of volatile nitrogen at 30°C is at least 8 times the velocity at 0°C, and so sardines will spoil within few hours, if they are not properly kept in ice.

No tuna has been available at the beginning of April, but the shrimps investigated have proved to be of good quality and can be compared to the deep sea shrimps of southern Norway in size and texture.

III. Investigation on the ready made cans.

At the Bandar Abbas factory a number of ready made cans were inspected. The cans were taken from the stores at random and in addition definite swells were taken out for examinations.

a. Sardines.

The labels were pretty well kept, in some cases they were stained. In Scandinavia brighter colours are normally preferred, as they more effectively cover staining. The wrapping paper was in all cases in good condition.

The outsides of all cans inspected were unpleasantly oily due to the fact, that no washing had been performed before the retorting, however, the oil had protected against corrosion of the outsides of the cans.

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On opening the cans by means of a can key, all lids broke perfectly as they should, but in one case the key was broken.

In all cases sulphur staining on the inside of the cans was found, and the laquer had loosened. This no doubt is due to the fact, that the cans had been stored for too long period at too high temperatures.

All sardines had been packed with the scales on, and the scales had most unpleasant taste. It was stated, that descaling had been tried, but had been given up because fifty per cent of the raw material was lost in this operation due to the stale condition of the raw fish.

In some cases, sardines with burst stomachs had been packed with first class sardines, since it would have been impossible to run the factory, if all second grade raw material had been rejected.

The taste and smell was good, but the texture perhaps a little dry. The canning and sterilizing had in all cases been sufficient and no bacterial spoilage was found. All smells inspected were due to hydrogen formation in the cans, caused by attack on the metal by the content and promoted by high temperature during storage.

b. Tuna.

All labels inspected were heavily impaired by oil and dirt, and as in the case of sardines all cans were unpleasantly oily on the outside.

All cans showed heavy inside sulphur staining, especially the lids due to the fact that the lids had been deep drawn with the laquer outside.

The colour of the tuna meat was pink and good, the taste and smell very slightly rancid. The texture was somewhat tough, due to the fact, that no proper steam cooker is found in the factory. The size of the meat slices was fair considered as a standard pack. No bacterial swells were found, but heavy hydrogen swells occurred.

c. White fish.

The sulphur staining, especially on the lids, which had the laquer on the outside, was so heavy, that all cans of this material must be condemned. Many hydrogen swells occurred.

IV. Some scandinavian regulations for sardine canning.

It might be useful to compare some of the points which are considered important in Scandinavia, with conditions on the Persian Gulf

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It is forbidden to can sardines, which are less than 9 cm. All sardines must be quite fresh and unsmoked. Only first class can-

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material must be used. It is forbidden to can sardines with burst stomachs.

The oil content of the sardines shall be at least 7%, and sardines with less than 7% oil must be specially labeled and should be sold at a lower rate.

All transport must take place in proper fish boxes. (See special regulation.)

All heads and gills to be removed carefully.

For smoking purposes only wood must be allowed.

All canned goods must be stored at low temperature, i.e. between 15°C and 3°C, since the possible time of storage is diminished to half, for each 10° increase of storage temperatures. The canned goods must not be allowed to freeze.

V. Possibilities of improving the quality of production.

Having considered the raw materials and the ready made cans in the connection with the main scandinavian regulations, it will be possible to draw some conclusions on the possibilities of improving the quality of the production.

The most important point is the fish transport from the catching areas to the factory. It is absolutely necessary, that the sardines be cooled down with ice immediately after the catch and packed in proper boxes, so that to avoid pressure on the fish which causes bursting of the stomachs and thus makes the fish useless as raw material.

If the fishing is performed by motorized boats, these should be furnished with insulated holds and refrigerators, and if the fishing is performed by local fishermen, motorized transport boats with insulated refrigerated holds should be available to collect the fish as soon as they are caught.

The time of transportation should be as short as possible. No doubt the pier, which is planned to be built at the factory will prove very useful, for in this way the fish could be brought to the factory in time to process on the day of catch. The factory should of course have adequate cooling rooms for storing the fish in ice, until they can be processed.

The next point is the descaling of the sardines which will be possible when the raw material is in first class condition. A modern sardine scaler as per specification VIII d should be attached to the factory.

The unpleasant oiliness of the outer surfaces of the cans can be overcome by using a modern automatic can washing machine as per specification VIII g.

The inside corrosion of the cans can be avoided by seaming the cans in an automatic vacuum seaming machine and in this way lowering ./..

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the oxygen content of the cans, which process will also be useful for avoiding rancidification of the oil in the cans. Vacuum seaming machines are found for round cans, and if it is not possible to get one for square and oval cans, great care should be taken for proper storing of the cans. In any case an automatic seaming machine should be supplied in order to work together with the can washing machine, since this will greatly facilitate the production.

For proper processing of tuna a steam cooking cabinet should be made according to specification VIII b.

The storage rooms for olive oil, tomato sauce and processed cans should be constantly kept at maximum 15°C, and care should be taken to keep the humidity in the room low in order to prevent outside corrosion of the cans.

It will appear from the analyses, that the oil content of the sardines is somewhat lower, than permitted in Scandinavia, and it is recommended that experiments be carried out in the next season in order to determine whether an oil cook of the sardines after smoking would be preferable.

VI. The present state of the factory.

In general the factory has been very well preserved. No severe damages was found in the buildings or machinery. This is mainly due to the care which has been taken to keep the machines well oiled and greased during the idle periods.

Generally it can be said, that almost all defects have been caused by the presence of the salt in the underground and sea water. Oil tanks, tubes, steam boiler etc. have been impaired by corrosion from the salt.

a. Buildings.

It appears, that the construction, consisting of steel frames covered by asbestos-cement boards, has been able to stand the climate extremely well, and the only damages found were due to breaks from impact. The main crack is found in the outside wall of the ice machinery room, and it is important that it be repaired, since otherwise the insulating cork boards will be damaged. The floor in the main hall is being repaired at present.

b. Main hall.

All boxes for fish transport and storage must be renewed, for they are far below the minimum requirements for fish boxes.

The scale for weighing the fish is mainly in order, but the ticket stamping arrangement needs repair.

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The tables for deheading, degutting and cutting of the tails could be covered advantageously with a thin plate of stainless steel. This would greatly facilitate cleaning and maintaining sanitary conditions. Since it would not be possible to cut fish on metal, 100 cutting boards 660 x 457 sq. mm should be made from 18 mm plywood, and treated with linseed oil.

No buckets for offal are found and it must be recommended to purchase 50 galvanized buckets to provide one bucket at each working place. The buckets should be emptied into galvanized transport cars with large diameter wheels. This will greatly facilitate the transportation of the offal to the fish meal factory, and at least four of these cars should be provided.

All knives and scissors of the factory are said to be useless on account of rust, and at least 120 knives and 120 scissors are necessary. For the salting of the sardines there are 6 barrels each 400 liter which are sufficient. All salting frames are spoiled, and it will be necessary to provide new frames, these however could be made locally.

The waggonets for transport of fish boxes and smoking frames adequate and in order, as are the tables for placing sardines on smoking frames and for packing the sardines into the cans.

At least 500 galvanized trays are available for the filled cans which is sufficient.

c. Smoking cabinets.

The inside brickwork of the smoking cabinets will be useful for several more seasons but the concrete wall behind the cabinets is cracked and needs repair.

The upper parts of the iron front doors are in good order, but the handles should be insulated in order to protect the hands of the labourers.

The lower parts of the same doors have all been impaired by the heat, and all iron plates for air regulation have to be renewed.

The frame supporters are all in good order, except that of the last cabinet to the right one which is missing.

The iron plate cover of the smoking duct and the chimney must be renewed, as they are perforated by heavy corrosion.

A duct with fan should be provided from the screen over the cabinets direct to the outside so that all smoke and heat, coming from the cabinets will be removed immediately thus avoiding contamination of conditioned hall.

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The smoking frames, of which 116 are present, are in bad condition and 300 new frames should be provided.

11 pallets for the transport of the smoking frames are in order and so are the 4 waggonets used for the same purpose.

d. Seaming machines.

The four seaming machines, which are of the semi-automatic type have been well maintained, and the inspection of the cans showed that all seams were tight. However to day this type is only used for seaming of only small production items of a cannery, such as shrimps. For sealing of the main production canning automatic machines should be used. These machines demand less handwork and facilitate the flow of production, and it is therefore proposed to remove two of the present machines and to replace them with a modern automatic double seaming machine as per specification will f. The replaced machines should be kept in store as reserve. Spare top plates for holding the lids are needed.

e. Autoclave section.

The two fish cookers with 4 baskets are heavily corroded, but after careful cleaning would be useful for another couple of years.

The shrimp cooker made from stainless steel and furnished with steam jacket has been damaged by too high steam pressure, but can be repaired locally. The safety valve on the steam jacket should be carefully inspected, before this cooker is taken into use again. The condenser pot of the cooker is ruined by corrosion and should be replaced.

The big super pressure autoclave is in a good condition and no corrosion is found inside the autoclave itself. The main packing must be replaced and spare packings purchased.

The automatic temperature and pressure controller is out of order but repair is not recommended, since in most canneries the autoclaves today are regulated by hand. The system could be removed.

The automatic temperature and pressure recorder must be considered of utmost importance, and as a spring is said to be broken in this instrument, it should be sent to Teneran for repair. The water level glasses on the retort and on the water heater, which have been taken away, should be replaced. All safety valves should be carefully inspected and tested, before the autoclave is taken into use again.

The motor for the water pump has been taken away and must be replaced so that the autoclave may be operated properly and heat saved.

The water heater shows some inside corrosion, and it should be submitted to a water pressure test, before the autoclave is used.

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Some corroded tubes likely will have to be replaced as well be indicated in the pressure test. The 36 baskets for the autoclave are in order, and so are the 12 transport trucks.

The small vertical autoclave needs a complete overhaul, all packings renewed, and the lid adjusted. However only very slight corrosion is found, and the autoclave should be useful again. (NB Pressure test). The four baskets for this autoclave are in order.

f. Can making plant.

Two foot power shears are in good condition and need no repair. One oiling machine for tin plate is also in good condition. Three heavy presses for deep-drawing of can bodies are well preserved, but the tools for ½ dingley, flat club and ½ oval cans, two pieces of each need and adjustment and should be sent to Denmark for same. Three presses for the lids are also well preserved and so are the tools, but 3 pieces of spare part No 674 should be ordered from Denmark. Four tongue presses are well kept, but spare tools for ½ oval lids are needed. Three rubber vulcanizing machines are in good order, but the pipe from the acetylene gas container to the machines is corroded and must be replaced. The can key machine can be used, but no spare parts are present, and 10 punches and 10 knives for the machine should be supplied.

g. Steam boiler plant.

The 30 sq. m steam boiler has been used for 8 years without any purification of the feed water. From inside inspection of the boiler it was found, that there were no deposits on the sides, but that the flame tubes were all heavily corroded and must be replaced. The corrosion of the inside plates of the boiler was not great. The condition of the boiler is due to the fact, that the fresh water of the factory is salty, but not hard, and in order to protect the boiler a water distillation plant was sent from Denmark at the beginning of the war. This plant however disappeared enroute. All fire tubes should be replaced and a water pressure test must definitely be carried out, before the boiler is started up again. Furthermore a new distillation plant should be installed, using the present water tank as feed water tank for the boiler. (Specification VIII i)

The oil burner is said to be in order, as is the feed water pump.

The insulation of the boiler must be repaired after the replacement of the tubes.

h. Power plant.

The two big Diesels are in order, but a careful inside inspection and cleaning no doubt would prove useful. Some small spare parts, such as springs and thermometers are needed. The two small generators are also in order and the same is true of the main switch board.

e/....

The oil tank is still tight, but it must be expected, that some outside corrosion has taken place, due to the salt content of the underground. The hand pumps for oil and the feed containers are in order.

I. Ice plant.

The larger compressor, the oil separator and the ammonia receiver all seem to be in good condition. The capacity of the condenser for the ice plant most likely has decreased because of scale formation on the inside of the tubes occasioned by deposits from the sea water. It should be inspected and cleaned inside. The ice tank is somewhat rusty on the inside, but it can be easily cleaned. The refrigerator coil in the ice tank will also need cleaning. The brine should be adjusted to the right PH.

The hoist for the ice cans is in order, but several of the cans are badly corroded, and it is recommended that a new set of heavy galvanized cans be supplied. The brine circulator and the ice crusher as well as the coils in the ice store are in order. The small compressor is said to be in good condition and so is its oil separator. The condenser will no doubt need an inside inspection.

The two air-conditioners are said to be in good order, but ball bearings are needed for the motors for the water pumps.

K. Workshop.

All big machines such as boring, shaping and sawing machines are in order. The turning machine is also useful, but can only be worked on three velocities. The plate shear and the grinding machine as well as the acetylene gas work are in order.

An electric transformer for electric welding is recommended, as it would prove very useful to the factory.

As there will always be a good deal of carpentry work to be performed, such as fish boxes, smoking frames, cutting boards, etc., it is recommended that a small carpentry, consisting of circular saw, planer, benches and the necessary hand tools, be purchased.

L. Stores.

For full scale production, the ice store will prove to be too small for both ice and iced fish, and a considerable extension to this part of the factory is recommended. However, since the re-plant on the whole Persian Gulf area will recommend a fish freezing integrated unit,

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The store for processed cans, for olive oil and tomato souce will hold abt 1 Million cans, but readings have proved, that the temperature is normally in this part of the year (beginning of April) about 25 °C in the store, and this must be considered to be too high. It is recommended, that the store with the cellar be insulated with cork boards and that cooling coils be installed. At the same time care should be taken to keep the humidity of the store fairly low in order to prevent outside corrosion of the cans.

The refrigerating coils of the tin plate store could be omitted.

m. Pipe lines.

The sweet water pipes are now and then replaced on account of salt corrosion, this is made locally. The sea water pipe, heavily damaged by corrosion and a part of the pipe line has been removed, and thus it is only possible to pump at high tide. The system must definitely be repaired, but as a pier will be built, it be advisable to postpone the main repair until the pier has been built and to utilize it as a support for the pipe line. In this way inspection and repair would be greatly facilitated. The sea water pump is somewhat leaky, but should be repaired locally.

n. Fish meal factory.

The fish meal factory has only been used very slightly and no wear is found in the machinery. As the machines have also been well kept, corrosion is negligible. The mining machine is in order, as are all conveyors, cooker, screwpress, vibration screen, oil separators, centrifuge, drying oven, fans, dust collector and hammer mill. The sea water pump and some of the motors have been removed, but are said to be in store.

VII. Proposals for the future Working of the factory.

a. Canning factory.

Having now considered the difficulties during the past period of working and the present state of the factory it is possible to make a proposal for the future operations.

Main efforts should be directed to the necessity of giving the factory a regular and adequate supply of first class raw materials. This can be obtained in two ways.

The local fishing of sardines can be exploited at Hormuz and at the northern part of Qeshm if the factory is supplied with a refrigerated transport boat, which would be able to carry ice and fish boxes to the areas mentioned, pack down the sardines immediately after they have been taken out of the water and carry them directly to the pier of the factory. The Danish boat Sangnar will after repair, according to Specification VII.

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The sardine fishing at the southern side of Queshm will be more difficult to exploit, as the distance to the factory is abt. 80 km. If fishing has to be extended to this location a small insulated store should built at the point of landing, furnished with a small refrigerator and the iced sardines should be transported by insulated lorry to the point of Queshm, which is nearest to the factory. The lorry must take back ice and fish boxes to the catching point. As the road however is said to be in a rather bad condition, this development should be postponed.

In order to secure a regular supply of raw material, it is recommended that four Danish fishing boats be attached to the factory and provided with insulated stores and refrigerators according to specification VIII b.

Upon landing the fish should be taken to the canning factory or to the cooled store, connected to the freezing station. The ice is preferably made at the same station in the form of direct made slice ice, since this kind of ice is better fitted for fish packing than the crushed block ice.

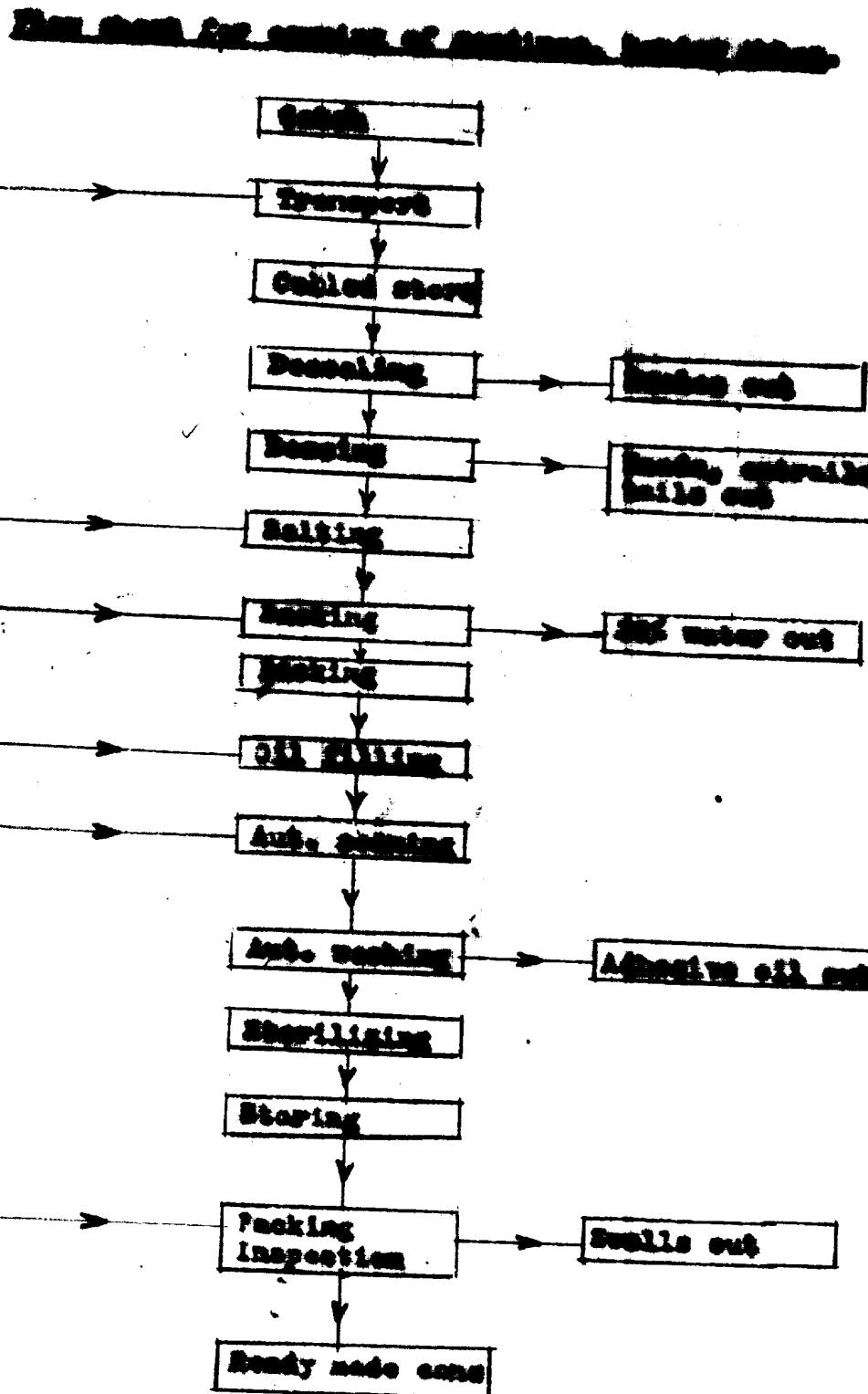
In the operation of the canning factory, mechanization should be applied to those steps of production which are common to all products, such as seaming, can washing etc.. When the sardines are taken into the canning factory, they should be first descaled in a rotary scaling machine according to specification VIII d, then they should be covered with sliced ice and taken to the dressing tables, where heads, entrails and tails are removed. The tables should be altered according to specification VIII e.

After dressing the fish are put on frames and salted and washed in barrels. If the production increases quickly, continuous washing machines should be considered. The salted fish are taken to tables for placing on smoking frames and are smoked in normal fashion. The placing of the smoked fish into the cans also takes place in the normal way.

After oil filling the cans are sealed in an automatic seaming machine, preferably with vacuum, according to specification VIII f and the cans are hereafter cleaned in an automatic can washing and cleaning machine, according to specification VIII g. The sterilizing is performed in the normal way. The processed cans are stored in the cooled store at maximum 15°C for one month, whereafter they are packed and labeled and at the same time swells are graded out.

Tuna are to be bled immediately after catch, while still living, i.e. the fish are cut just behind the head from the underside to the backbone, but without cutting it, so that the blood will come out. Hereafter the entrails and gills are removed, the fish are washed in sea water and packed in ice with bottom cavity downwards.

At the factory the fish are washed in ice water and cooked in a steam cooker, according to specification VIII h. The useful light meat is separated from the bones and divided into slices, suitable for the cans. Seaming, retorting and labelling to be performed in the normal way.



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b. Fish meal factory.

The present factory is designed according to the so-called wet-pressing method, which is applicable particularly to fish containing oil. However it has been shown by analyses in the laboratory and by experience, that the oil content of the fish in the Persian Gulf is very low, and since, furthermore, the purpose of the fish meal plant is primarily to make fertilizers, the wet-pressing method is recommended since 20% of the nitrogen content of the fish and 80% of the water soluble salts are lost in this process.

The plant should be transformed into a direct drying plant the operation of which is as follows:

The raw material is cut in pieces and minced in a mincer then mixed with some processed fish meal in a screw conveyor and taken directly into the rotating drying oven. The addition of processed fish meal is necessary in order to prevent burning and sticking to the drum cylinder.

At Linge and Jack 100 Ton per year of dried stolephorus fish are said to be prepared for fertilizer purposes. This product could be taken to the factory, milled and added to the raw material in order to secure the proper water content and instead of adding processed fish meal.

As sufficient conveyors are found, only minor alterations are necessary. The steam cooker and the screw press could be taken away, but the remaining part of the factory could be kept as it is.

A special attention should be given to the processing of sharks. Analyses in the laboratory have proved, that the oil content of the livers of some species is abt. 75% and according to experience from Ceylon and other places, one can expect that the Vitamin A content of the oil is abt. 2-3,00 International Units, which is higher than in Cod liver oil, normally prepared in Scandinavia. The Vitamin D content of shark liver oil is very low, but as tuna liver oil is extremely rich in this Vitamin, a perfect medical oil could be obtained by combining shark and tuna livers as raw materials.

Most likely a great part of the eye illnesses in this country are due to deficiency of Vitamin A, and it is strongly recommended to make use of the Vitamin sources in the Gulf.

The production needs a mincer, a steam cooker and a centrifuge, and of these machines the last mentioned is already present.

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It is however necessary to destearinate the oil, since it contains too much saturated sterines for direct sale, but the destearinating plant could easily be attached to the freezing station.

Sharks have been given too little attention in this country so far, as they are not used as food. But apart from the oil in the liver, the sharks contain in the meat abt 1% of Urea, which is very valuable for fertiliser purposes, and as analyses in the laboratory have proved, that the oil content of the shark meat is less than 0.4%, the shark carcasses could easily be worked up in the altered fish fertilizer plant.

In this connection attention should be drawn to page 38 in Dr. Blegvaads books "Fishes in the Persian Gulf", where it is stated: Altogether no other fish was caught so frequently as *Carcharias monoserrah* (a shark), which was taken at 78 out of 137 stations. In spite of this fact the fish is not used at all by the Iranian fishermen.

VIII. Specifications for proposed machinery.

a. Pier.

As the pier has already been designed, it shall only be mentioned, that it must be possible to land fish even at low tide.

The pier could be furnished with rails for fish transport and could be used as a support for the sea water pipe.

A roof for protection of theiced fish against direct sunlight is recommended. The transport trucks for fish should be closed and insulated.

b. Boats.

1. Transport boat.

The old Danish boat *Søngsvær* has been sunk twice and its installations are heavily impaired. However the boat could be useful for fish transport over short distances, but the present speed 3 - 4 miles per hour must be considered insufficient for long distance transport. The hull does not appear bad, but an inspection by taking the boat ashore will be necessary. The engine is still working, but needs an overhaul. The refrigerating system is completely spoiled and must be removed as neither compressor, oil separator, condenser or servo motor are present. Some cooling pipes, which remain in the store room, cannot be considered reliable. The insulation of the store room must be inspected and most likely replaced.

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A radio transmitter and receiver is recommended in order to make it possible to announce in advance to the factory the fish quantities obtained.

The winch on the deck must be repaired and installations made for the speedy loading and unloading of fish and fish boxes. All installations not necessary such as the fish boxes on the deck to be taken away. All spoiled wooden parts to be renewed and the boat thoroughly painted. Sanitary installations such as Kitchen and toilet should be repaired.

2. Fishing boats.

At least four motor fishing boats should be attached to the factory. It is recommended to purchase 2 boats, each 45 tons brut, provided with semidiesel engines abt. 200 hp and 2 boats, each 35 tons brut, provided with semidiesel engines abt. 150 hp. Speed abt. 10 miles per hour. All boats should have insulated rooms with refrigerators to keep the temperature at minus 1°C. by means of sea water of 30 °C. The cooling medium should be ammonia. The compressors should be worked by auxiliary motors. The boats should be furnished with winches for bottom trawl, atomic trawl, Danish seine and should also be fitted for long line fishing.

The two bigger boats should be furnished with echo sounders with recorders and all boats to be equipped with radio transmitters and receivers. The winches should be fit for speedy loading and unloading of fish and fish boxes and necessary installations for this purpose should be made.

The gears should be the following:

16 bottom trawls, 4 for each boat.
 " "
8 danish seines,
4 atomic trawls

40,000 hooks for long line fishing; in different sizes. Lines for same. Side lines to be made from german silver and Nylon.

8 stake nets, Danish type with impregnated poles.

Necessary tools for repair, tar and oil for impregnation of the nets.

It will appear, that the boats proposed are rather strongly powered. This is due to the fact, that the fish in this waters are fairly speedy and it must be possible to work the trawls with good velocity. Furthermore the time of transportation must not be too long.

c. Ice work and cooled store.

To the central freezing plant, which will be proposed in the next report, an ice plant with a capacity of 10 ton of ice per 24 hours should be attached. The ice should be directly made sliced ice which is preferable for packing of fish. An ice store, holding 30 ton of ready made ice is also recommended.

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The cool store for iced fish must be able to hold at least 50 tons of fish as raw material for the canning factory, the freezing plant, the fish fertilizer plant and the fish liver oil plant.

d. Sardine scaler.

The sardine scaler must be of the rotating drum type with inside water spray. It should be able to descale 1 ton of sardines per hour efficiently, but the treatment of the fish should be careful to avoid bursted stomachs when treating normal fresh raw material.

A length of 2.5 -3.0 m and a diameter of abt. 1.0 m would be suitable for this drum.

The scaler must be furnished with motor for 3 phase x 220 Volt a.c.

e. Dressing tables.

The dressing tables should be covered with 1 mm stainless steel plate, sloping slightly to the middle of the tables where a duct for sweet water and ice water should be installed.

f. Automatic seaming machine.

The automatic double seaming machine must be able to seam 2500 cans per hour and be furnished with the necessary tools for seaming 4 Dingley, 4 Club and 4 oval cans. The cans should be transported roller conveyor. The lids to be placed on the can bodies automatically. The machine must be provided with motor for 3 phase x 220 volt a.c.

Alternate tender for the same machine, provided with vacuum sealing should be requested.

g. Automatic can washer and rinser.

The automatic can washer and rinser should take the cans from the seaming machine. It should be completely enclosed except for inlet and outlet. Dimensions abt. 1.5 x 3.0 m. Complete washing to be performed by passing the cans through cleaning compartment, where they are subjected to a concentrated spray of detergent solution under pressure. Rinsing compartment abt. 2.5m long should spray the cans with clear water, as they pass through. Motor for 3 phase x 220 volt a.c. should be provided with the machine.

h. Steam cooker for tuna.

The steam cooker for tuna should be built as a steel cabinet length 1.5m, width 1.0 m, height 1.5. It should be provided with steel tubes for live steam and with drain for condenser and water.

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The cooker to be furnished with easy movable steel door, suitably packed. The tuns to be placed on trays covered with metal netting. 10 shelves, each of 3 trays. The cooker should be provided with gauge pipes in order to avoid a pressure over atmospheric in the cabinet.

i. Distillator for feed water.

The distillator should be able to produce 250 kg sweet water per hour from sea water or other salty waters. Carry over during operation should not be more than 1%. The distillator is to be complete with necessary valves, condenser pot and motors for 3 phase x 220 Volt a.c. Container for distilled water not to be included, but the tender must include a pump for taking the sweet water to a container. The evaporator tubes must be easily cleaned mechanically.

j. Tools for deep drawing of round cans.

The tools must be fit for deep drawing of 1 lbs round aluminum cans, but also tin plates may be processed. The tools must fit ATLAS A.I.I. 4 eccentric press. Corresponding tools for lids are to be included. These must fit for ATLAS A.I. 6 eccentric presses.

K. Cooling of store for cans.

Necessary coils for cooling the can stores 133.5 x 3.0 x 4 meters and for a collar below the store 13.3 x 3.0 x 2.0 meters are to be provided. Outside temperature 30° F., the store to be kept at maximum 15° C. At the cooling plant, compressor, 12 at disposal. Special attention should be given to humidity in the rooms, which must be kept low in order to prevent outside corrosion of the cans. Necessary insulation materials, preferably cork boards to be provided.

l. Fish meal factory.

The raw fish to be taken directly thru a mincer to drying drum. Return conveyor from dry meal section to beginning of raw material conveyor to be made, arrangements drawn & tender from the ATLAS Comp., Copenhagen should be requested as this company is well acquainted with the present plant and knows the direct drying method proposed.

m. Fish liver oil plant.

For preparation of shark liver oil following apparatus should be provided:

1 liver press for abt 300 kg per hour, complete with pressure cooker, pressure gauge, filter cloths, valves and motors for 3 x 220 Volt. a.c.

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1 Container for the processed liver.

a. De-stearinating plant.

The de-stearinating plant should be able to treat 1 ton of crude shark liver oil per 24 hours. 20% stearines must be expected. The liver oil should be cooled to 0°C.

The plant to consist of:

- 8 containers for temporary storage of crude oil.
- 1 oil pump.
- 1 double container for crystallization of the stearines.
- 1 filter press with pump.
- 1 container for refined oil.

b. Conserve specialists and fishermen.

It must be recommended, that one Danish canning specialist is engaged by the canning factory. One engineer, specialist in can manufacture should also be engaged.

In each boat 2 Danish fishermen shall be recommended, i.e. in all 8 fishermen.

Adequate rooms for this personnel must be present.

It is recommended, that the fishermen be paid partly on share basis, in order to make them interested in maximum catch.

IX. Specifications for new materials.

a. Tin plate.

The tin plates must be prime and the tin coating must be at least 0.3 gram of tin per 100 square cm surface. By the British "Hot water test" not more than 10 pores per square cm must appear. The lead content of the tin not to be more than 100 mg lead per 100 g tin.

The tin plate must be well suited for deep drawing of cans such as ½ oval, ½ dingley and ½ club. The softness of the plates must be appropriate for this purpose. The tin plate must be lacquered on one side. The lacquer to be free from poisonous materials. The lacquer coating must have sufficient thickness for adequate protection of the tin plate. The lacquer must not discolour canned goods, nor affect the smell or taste of same. The lacquer must be sufficiently adhesive to the can for proper deep drawing of oval, ½ dingley and ½ club cans. The lacquer must be able to stand re-torting at 120 °C for 60 minutes, and the adhesion to the tin plate should not be affected by this treatment. The lacquer must be suited for oil preserves and must be sulphur resistant. Under normal packing and processing, the lacquer should not stick to the fish.

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b. Rubber packings.

Plasticity. The packings must be able to stand pressing into a ball with the fingers without cracking.

Elasticity. The packings must be able to stand an extension of 50% without cracking. After this test they should not have been prolonged more than 20%.

Heat resistance. By dry heating at 170°C for 2 hours, the plasticity must be only slightly impaired.

Cooking resistance. By heating with water, 3% salt solution or 3.5% solution of tartaric acid at 100°C for 2 hours and thereafter at 120°C for 30 minutes the rubber must not lose its ductility, nor impart, taste or smell to the solutions.

Ash. The ash content should be 75 - 95%.

Sulphur. The packings must not split off hydrogen sulphide when cooked with 1% tartaric acid solution.

c. Olive oil.

The oil must be clear, free from water, mucilaginous substances and other impurities.

The color must be golden yellow, only slightly green or brown.

Taste and smell must be pure and good, and the content of free fatty acid must be below 1.7%.

The iodine figure must not be more than 35.

By storing the oil at 40°C no solid fats must precipitate.

The content of chemically refined oil must not be more than 30% in the mixture, and the chemically refined oil must be of good quality.

The olive oil must not contain chemically refined extraction oil.

The olive oil delivered must not have a rancidity of more than 10 red Lovitond units, determined by the quantitative Kreis test.

The ash content must not be more than 30 mg per 1 Liter of olive oil.

d. Tomato souce.

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The tomato souce must be packed in tins, adequate lacquered inside.

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2- The tomato sauce must have been manufactured from good raw material, which has not been impaired by moulds, yeasts or bacteria. The canned sauce must not contain any microorganisms, capable of developing at normal storage temperature.

3- The color should be bright red without any brown. The taste and smell should be fresh. The consistency should be smooth and only small amounts of shells and kernels will be tolerated.

4- Dry matter content not more than 30%. (Triple concentrate not acceptable).

5- Sugar content to be not less than 40% of the total dry matter content

6- Acid content, calculated as citric acid not to be more than 10% of the total dry matter content.

7- Water insoluble materials not to be more than 22% of the total dry matter content.

8- The salt content not to be more than 1% of the total dry matter content.

9- The tomato sauce must not contain other vegetable materials, such as carrots or pumpkins. No artificial colours nor germicides, other than sodium chloride will be tolerated.

10)-The metal contents per kg tomato sauce not to exceed:

Tin 100 mg
copper 25 mg
Lead 3 mg.

• Fish boxes.

Fish boxes for transport of raw fish for canning or freezing purposes must be made from planed material and must be provided with handles of good rope or the like. The boxes must be clean and light coloured.

All boxes must be carefully washed and dried immediately after use.

Boxes, consisting of material, which on account of steaming would turn grey, not to be allowed.

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X. Proposal for the starting of the factory 1950-1951.

It will appear from the above mentioned proposals and conclusions, that the main difficulties for the factory in the past years has been inadequate supply of raw material and transport difficulties. It is strongly recommended not to start the factory for full scale production until the necessary auxiliary equipment has been provided.

The Sangaar could be repaired at an early date, but it will take some time to get the necessary refrigerating system delivered and installed.

The Danish fishing vessels could most likely be present in January or February 1951, if they are ordered now, and the new machinery proposed for descaling of sardines, can washing and sealing and for cooling of the can stores could most likely be completely installed at the same time.

If Danish erectors are brought in the autumn of 1950, the fish meal plant and the fish liver oil plant could also be ready in January, and at the same time the machines now present could have been overhauled.

Regarding this situation, it is recommended that production start in February 1951. It is calculated that about 500,000 cans could be made in the season. At the same time the investigation by Dr. Elegvad could take place.

Before starting, it is recommended, that the sanitary facilities for the laborers for hand and body washing, and suitable clothes and toilets should be given due consideration.

XI. Summary.

The proposals for repairs, new machinery, spare parts etc. in the present report are summarized as follows:

To be performed in Bandar Abbas.

Fish boxes renewed.
Ticket stamping in scale required.
Tables covered with stainless steelplate.
100 cutting boards.
Frames for salting of sardines.
Concrete wall for smoking cabinets repaired.
Iron cover for smoking duct and chimney to be repaired.
Iron front doors of smoking cabinets required, handles insulated.
Duct and fan over smoking cabinets installed.
500 smoking frames to be made.
Cleaning of fish cookers.
Repair of

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Automatic temperature controller removed.
New water level glasses in autoclave and water heater.
Inspection of safety valves of autoclave, pressure test.
Motor of sweet water pump on autoclave reconnected.
Overhaul of small autoclave.
Repair of acetylene pipe for rubber vulcanizing machine.
Fire tubes in steam boiler replaced, pressure test.
Repair of insulation of steam boiler.
Overhaul of diesels.
Cleaning of condensers for ice plant.
Cleaning of ice tanks and refrigerator coils.
New ball bearings for air conditioners.
Replacement of sea water pipe.
Repair of sea water pumps.
Pier to be built.
Alteration of fish meal plant.

To be provided in Iran.

50 galvanized buckets.
120 knives
120 pairs of scissors.
Repair of temperature and pressure recorder.
Transformer for electric welding.
Carpentry, consisting of circle saw, planer, benches etc.
Repair of Sangsar.

To be provided from outside.

4 galvanized tracks for offal.
3 Main packings for autoclave and manholes in same.
Adjustment of tools for can bodies.
3 spare parts no 574 for lid presses.
Spare tools for $\frac{1}{2}$ oval lids for tongue press.
10 Punchers and 10 knives for key machine.
Water distillation plant.
Spare springs and spare thermometers for diesels.
108 heavy galvanized ice cans.
Refrigerator for Sangsar.
2 Danish fishing boats, each 45 tons brut.
2 Danish fishing boats, each 35 tons brut.
Gears for fishing boats.
Sardine scaling machine.
Automatic searing machine.
Automatic can washing machine.
Steam cooker for tuna.
Tools for deep drawing of $\frac{1}{2}$ lbs round can.
Cooling coils and insulation for can store.
1 Shark liver oil press with container.

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1 Destearinating plant. for shark liver oil.

Spare top plates for holding can lids in sealing
machines. 1 d, 1 club, 1 oral 2 prs. of each.

Tehran, April 15, 1950